

## REMARKS

With this response, Applicant is filing a certified copy of the foreign priority document. Also, Applicant sends replacement drawings to address the Examiner's objections. In these replacement drawings, the necessary figures have been labeled "prior art" and the detail numbers for the "prior art" figures have been corrected to identify like elements that do not overlap with the details in the figures describing the invention. The objection to the drawings under 37 C.F.R. 1.83(a) has been addressed in these replacement drawings, the amended claims, and the discussion below. Further, a new substitute specification is included. This new specification corrects references to details in the replacement drawings, makes changes suggested by the Examiner, and further clarifies the specification, but does not add new matter.

With the present amendment, claims 15-30 are pending. Claims 17 and 19-21 were rejected under 35 U.S.C. § 112 as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicant regards as the invention. Claims 15-18, 22, and 23 were rejected under 35 U.S.C. § 102(b) as being anticipated by Japanese Patent No. 07173727. Further, claim 22 has been provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 16 of Application No. 10/022811. Claims 29-30 have been allowed. Further, claims 24-28 were indicated as allowable but objected to as being dependent upon a rejected base claim.

Claims 24-26 and 28 have been amended into independent form and are now in condition for allowance. Claim 27 depends from claim 26 and is thus also in condition for allowance. With this Amendment, Applicant respectfully submits that the claims 17 and 19-21 as amended particularly point out and distinctly claim the subject matter which the

Applicant regards as the invention. Further, claims 15-18, 22, and 23 patentably define over the art of record for at least the reasons set forth herein.

Concerning the Examiner's rejection of claims 17 and 19-21 under 35 U.S.C. § 112, Applicant respectfully submits that claims 17 and 19-21 as amended herein are not indefinite. The Examiner rejected claim 17 because it was unclear whether Applicant meant one type of fiber was conveyed through one channel and a different type of fiber is conveyed through another channel or that a blend of different fibers is passed through both, or multiple, channels. Claim 17 includes the limitation "different types of fibers are primarily conveyed through each of the respective conveying channels." As amended, claim 17 now clearly states that one type of fiber is primarily conveyed through one channel and a different type of fiber is primarily conveyed through a different channel. However, Applicant still asserts that broader claims other than 17 cover conveying a blend of different fibers being conveyed through multiple channels.

In regards to claim 17, Applicant respectfully addresses the Examiner's concern of how a single fiber bundle being drafted can be kept from intermingling. In claim 17, the fiber bundle can be composed of a section of first fibers and a section of second fibers. Predominately, the section of first fibers are conveyed through one channel and, predominately, the second fibers are conveyed through another channel. It is well known in the art that drafting of fibers within a drafting zone more properly aligns the fibers parallel to each other rather than intermingling of the fibers. The fibers are never intermingled in a drafting zone like fibers would be in a blowroom or in opening equipment. Thus, any section of the product exiting the draft zone will still carry the predominate characteristics of that section of the product entering the drafting zone.

A common example for those skilled in the art is the production of heather yarn using draw frame blending instead of intimate blending performed in opening. Heather yarn produced by draw frame blending must go through at least one extra drawing process to produce a properly blended sliver. In draw frame blending, for example, an operator places a can of black polyester sliver in a draw frame creel along with five other cans of cotton sliver which are all drawn together through a first draw frame. The mixed sliver produced by this first draw frame has a predominate black streak of polyester running through it, because the fibers are predominately aligned with each other, not intermingled. This mixed sliver must go through at least one mixing draw frame which possesses a creel of nothing but mixed silver before it is considered blended, since the mixed sliver delivered from the first draw frame has a section which is predominately black polyester and a section which is predominately a "white" cotton.

Similarly, one skilled in the art knows that the same holds true for a fiber exiting a draft zone in an air jet spinning process. If a single sliver being fed into the drafting zone has a section which is primarily first fibers and a section which is primarily second fibers, then the fibers exiting the drafting zone will also have sections which are primarily first fibers and primarily second fibers. Therefore, the fibers exiting the drafting zone as described in the present application can have a single sliver having sections which are primarily first fibers and primarily second fibers that can be divisible.

Regarding claims 19-21, Applicant respectfully submits that these claims with the amended Figures 6 and 6b address the Examiner's 35 U.S.C. § 112 and 37 C.F.R. § 1.83(a) concerns. Figures 6 and 6b show two "fiber bundles" being fed to the two different conveying channels. As described above regarding a single fiber bundle being composed

of two sections, two fiber bundles can be predominately kept from intermingling when drafted together. For example, the same is true as above if two slivers were fed into the drafting zone of an air jet spinning process. If one sliver consisted of short fibers and a second sliver consisted of long fibers, then the fiber exiting the drafting zone would have a section which is primarily short fibers and a section which is primarily long fibers.

Concerning the Examiner's apprehension regarding independent claim 15 teaching a fiber bundle and dependent claim 19 teaching at least two fiber bundles, Applicant respectfully submits that claim 15 is not limited to just a single fiber bundle and that claim 19 adds a limitation which states that there are "at least two fiber bundles" being processed. Applicant submits that the use of the transitional phrase "comprising" as used in claim 15 does not exclude additional, unrecited elements, steps or limitations. Further, it is well settled by the Federal Circuit that the use of an indefinite article "a" and "an" when used in a patent claim means "one or more" when the claim contains an open-ended transitional phrase such as "comprising." See Tate Access Floors, Inc. v. Interface Architectural Resources, Inc., 279 F.3d 1357 (Fed. Cir. 2002); Crystal Semiconductor Corp. v. TriTech Microelectronics International, Inc., 246 F.3d 1336 (Fed. Cir. 2001); KCJ Corp. v. Kinetic Concepts, Inc., 223 F.3d 1351 (Fed. Cir. 2000). Therefore, Applicant respectfully submits that claim 19 claiming "at least two fibers bundles" can depend from claim 15 calling for "a fiber bundle."

For at least these reasons, claims 17 and 19-21 are definite and distinctly claim the invention, thereby overcoming any 35 U.S.C. § 112 rejections.

Concerning the rejection of claims 15-18, 22, and 23 as being anticipated by Japanese Patent No. 07173727 under 35 U.S.C. § 102(b), Applicant respectfully submits

that this reference does not disclose the present invention as claimed in claims 15-18, 22, and 23. Claim 15 discloses a method for spinning yarn from a fiber bundle that includes a step of incorporating fibers from respective conveying channels into the bundling point at different times by varying processing features between the respective conveying channels, while allowing the fibers in proper position to release ends about which incorporated ends can be wound. Similarly, claim 22 discloses an apparatus for spinning fiber bundles into a yarn which includes conveying channels being differently configured so as to differently process fibers conveyed therethrough such that the fibers from the respective conveying channels are incorporated into a bundling point at different times, while allowing the fibers in proper position to release ends about which incorporated ends can be wound. Respectfully, this apparatus patently defines the invention over all cited prior art. Specifically, Japanese Patent No. 07173727 does not disclose such a method or an apparatus.

Japanese Patent No. 07173727 discloses an air spinning device wherein a sliver is split into two sections of filaments with a central or linear filament section subjected to a false twist. As pointed out in the specification of the present invention, this false twist twists the linear filament section so that the ends of the peripheral filaments cannot release thereby preventing incorporated ends from winding around such free ends. Accordingly, Applicants respectfully submit that Japanese Patent No. 07173727 does not disclose a method or an apparatus which incorporates fibers from the respective conveying channels into the bundling point at different times by varying processing features between the respective conveying channels, while allowing fibers in proper position to release ends about which incorporated ends can be wound.

Regarding the provisional rejection of claim 22 under the judicially created doctrine of obviousness-type double patenting, Applicant respectfully submits the apparatus presented in claim 22 is patentably distinct from the core spun apparatus claimed by Application No. 10/022811 in claim 16 as presented in Preliminary Amendment of that application. Claim 22 of the present application discloses an apparatus for spinning fibers into a yarn having two different fiber conveying channels, both for transporting fibers. Claim 16 of Application No. 10/022811 calls for a core spun apparatus for spinning fibers and at least one continuous yarn into a core spun yarn having a fiber guide for conveying fibers and a thread guide for directing a yarn. Core spun yarns by their very definition are formed by spinning fibers around a filament yarn or a previously spun yarn, thus concealing the core yarn. Claim 22 is directed to spinning individual fibers in a spun yarn. Accordingly, the thread guide of Application No. 10/02281, which transports a yarn in the apparatus, serves a different purpose than either of the fiber conveying channels of the present application, which both deliver fibers. A yarn, while possibly being made of fibers, acts differently than unspun fibers. Therefore, by its very nature a thread guide is patentably different than a fiber conveying channel. For at least this reason, Applicant respectfully submits that claim 22 is patentably distinct from claim 16 in Application No. 10/022811 and should not be rejected on the grounds of obviousness-type double patenting.

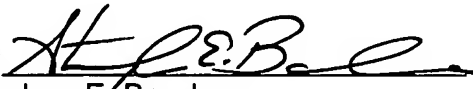
For at least the reasons listed above, Applicant submits that independent claims 15 and 22 are patently distinguishable from the prior art and are now allowable. Claims 16-21 depend from claim 15 and are thus allowable. Further, claim 23 depends from claim 22 and is also allowable. As stated above, claims 29-30 have been allowed. Also, claims 24-26 and 28 have been amended into independent form and are now allowable. Claim 27

depends from claim 26. Therefore, Applicant respectfully submits that claim 27 is also allowable. Applicant submits that the application is now in condition for allowance and favorable action thereon is respectfully requested. The Examiner is encouraged to call the undersigned at his convenience to resolve any remaining issues.

Respectfully submitted,

DORITY & MANNING, P.A.

Date: 11/19/03

By:   
Stephen E. Bondura  
Reg. No: 35,070  
P.O. Box 1449  
Greenville, SC 29602-1449  
(864) 271-1592  
Fax (864) 233-7342

**PATENT APPLICATION**

**ATTORNEY DOCKET NO.: OBJ-2880**

**TITLE OF THE INVENTION**

**SPINNING DEVICE FOR FORMING A THREAD FROM FIBERS**

The invention relates to a method and device for the manufacture of a spun thread from a fibre structure wherein fibers are subjected to a rotating air flow at the intake mouth of a spindle yarn channel to form a thread.

**BACKGROUND**

Such a device is known from DE 4431761 C2 (US 5528895) and is shown in Figures 1 and 1a. Therein, fibres <sup>F'</sup> are guided through a fibre guide channel 103 from a fibre guide surface 104b via an end edge 104c of a fiber guide cone 104 and around what is referred to as a needle 105, into a yarn aperture 107 of what is referred to as a spindle 106, whereby the rear part of the fibres <sup>F'</sup> are wound around the front part of the fibres already located in the yarn passage by means of a turbulent flow created by nozzles 103, as a result of which a yarn is formed. This is then spun in accordance with a method which is described in connection with the invention.

The item referred to as the needle <sup>105</sup> and its tip, about which the fibres are guided, is located in the vicinity or in the intake aperture 106c of the yarn passage 107, and serves as what is referred to as a false yarn core, in order to prevent as far as possible, or to reduce, the possibility of the fibres in the fibre guide channel causing a false twist to the fibres, impermissibly high for the fibres concerned and leading to snarling, which at the least will interfere with the formation of the yarn if not preventing it altogether.



Figure 1b shows the prior art known from DE 4131059 C2 (US5211001), which suffers from disadvantages in comparison with the invention from DE 4431761 C2, in which, as is known from Figure 5 in DE 4431761, the fibres <sup>F'</sup> are not consistently drawn around the needle <sup>105'</sup> as Figure 1a shows, but are guided on both sides of this needle <sup>105'</sup> against the intake aperture of the yarn passage, which apparently may interfere with the binding of the fibres <sup>F'</sup> and apparently may reduce the strength of the spun yarn.

Figure 1c shows a further development of the invention from Figure 1a, in which the fibre guide surface is designed, as can be seen, in helical form, and the fibres are accordingly likewise guided in helical manner in their course from the clamping gap X' as far as the end e5' of the helical surface, and are then again wound in helical fashion about a fibre guide pin, similar to the ~~fibre guide pin~~ <sup>needle</sup> of Figure 1, before the fibres are taken up by the rotating air flow and rotated into a yarn Y'. In this situation, it can be seen that the free ends of the fibres <sup>F'</sup> <sup>206</sup> are taken up by the rotating air flow and bent around the mouth section of the spindle <sup>206</sup>, and in this situation are wound around the ends incorporated in the fibre bundle, which are already located in the center of the fibre run, in order in this way to form the yarn. Figure 1c derives from DE 19603291 A1 (US 5647197) and ~~was adopted with the identification references assigned therein, without these reference being adopted into this text with a corresponding clarification, which incidentally also applies to all the figures adopted from the prior art.~~ Only the spindle <sup>206</sup>, the yarn passage <sup>207</sup>, and their air extraction cavity <sup>208</sup> of Figure 1 were adopted herein, while the element e2', which has a similar function to the needle <sup>105'</sup> of Figures 1 to 1b, was left thus.

It can be seen from these figures that the primary aim of the prior art lay in avoiding a false twist of the fibre bundle from the spindle back to the clamping point X, but, on the other hand, it can also be seen that the fibre flow must be designed in such a way that free ends, to advantage the rear ends seen in the direction of the run, are available in order to be wound around the part of the fibre already located in the yarn passage, in order thereby to form the yarn Y.

It was not the object of the prior art to have available at the intake aperture of the spindle sufficient, and sufficiently long, free ends in order to wind them about the ends located incorporated in the core, in order to obtain a yarn of sufficient quality.

A further prior art from the same applicant as that of Figures 1 to 1c is described in DE 42 25 243 (US5295349) and shown with Figures 2 to 2c, in which account is taken of the situation last referred to, and appropriate preventive precautions taken to separate the free (rear) ends of the fibre better for twisting by the rotating air flow. This was achieved by the fact that the fibre bundle is divided into at least two parts, also referred to as fibre strips, by way of a channel being provided for each part, which end before reaching the said needle <sup>305</sup> or the cone <sup>304</sup> respectively, as shown in Figures 2 and 2a. In Figures 2c and 2b, an example is shown with two channels <sup>created by element 318a</sup> whereby, according to the description of this patent specification, this may involve two closed channels in each case, by contrast with Figure 2b and 2c, in which a connection is provided between the channels.

The disadvantage of this prior art, however, still lies in the unsatisfactory differentiation between core fibres and winding fibres from the fibre bundle delivered

from the output rollers of a drafting device, in order to ensure that sufficient wound fibres, or sufficient free ends, are available for the winding.

Accordingly, the same applicant has disclosed, in the Japanese applications J7-173727 and J7-173728, a spinning device (see Fig. 3 and 3a) which on the one hand features two channels, specifically one channel<sup>405a</sup> for core fibers and one channel<sup>405b</sup> parallel to this for winding fibres. The special feature of this lies in the fact that core fibres are falsely twisted by means of a twisting medium (air) present in fibre channel of the spindle<sup>404</sup> as far back as the clamping point<sup>X'</sup> of the rollers delivering the fibre bundle, and specifically in such a way that the certain fibres are not taken up by this false twisting effect, and are delivered in the parallel channel<sup>405b</sup> against the intake aperture of the spindle.

① → If the prior art of Figures 1 to 2c are compared with this prior art, it can be seen that the basic principle, that of avoiding a false twist as far back as the clamping gap, is sacrificed in this prior art in favour of obtaining a division into core fibres and sheath fibres.

The disadvantage of the latter prior art, however, lies in the fact that it is difficult, with the pure provision of twist to form the false fibre bundle, to obtain the correct number of peripheral fibres, and that, on the other hand, false-twisted fibres are no longer in a position to release ends about which the incorporated ends can be wound, with the result that there remains an indeterminate provision of peripheral fibres for the formation of the yarn.

It is further mentioned in DE 4131059 C2 that an interval is provided between the intake aperture of the spindle<sup>206</sup> and the clamping gap X', designated in Figure 1c by B',

greater than half the mean fibre length but smaller than 1.5 times the mean fibre length, in order on the one hand to obtain sufficiently long fibre ends for the winding, and, on the other, not to release these fibre ends too early from clamping in the clamping gap X'. The disadvantage arises on the one hand in the somewhat vague concept of the mean fibre length and, on the other, in the large range between the half of the mean fibre length and one and a half times the length.

### **SUMMARY**

It is therefore a principal object of our invention to obtain core fibres and sheath fibres in such a way that an optimum number of fibres can be obtained with an optimum winding length. Additional objects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

The invention resolves this object in accordance with the characterization of the first independent method claim and first independent device claim.

Further advantages embodiments are described in the dependent sub-claims.

The advantage of the invention lies in the fact that with more than one interval between the clamping line of the output pair of rollers, or the fibre discharge line of the suction drum and intake aperture of the spindle, more fibres reach the binding area with their front or preceding ends before the not yet integrated, preferably rear ends, seen in the direction of the run of the fibre, have left the clamping line or the fibre discharge line, in order thereby to optimize better the winding length.

Generally spoken, "rear"- or "front"- ends are not limiting terms and refer to "not yet integrated" and "preceding" ends, respectively.

### **BRIEF DESCRIPTION OF THE FIGURES**

The invention is presented in the embodiments of the following figures. These show:

Fig. 1: A longitudinal section through a spinning device from DE 4431761 C2.

Fig. 1a and 1b: One figure each from the aforesaid DE specification.

Fig. 1c: A figure from DE 19603291 A1.

Fig. 2: A longitudinal section through a spinning device from DE 4225243 (corresponds to the preamble from the first claim of the present invention).

Figs. 2a to 2c: Further details from DE 4225243.

Fig. 3: A longitudinal section through a spinning device from JP 173727 and JP 173728 (corresponding likewise to the preamble to the first claim of the present invention).

Figs. 4 and 4a: One longitudinal section each through a drafting device and through a spinning device as a basis for the representation of the following Figures 6 to 6c and 7 to 7c representing the invention.

Fig. 5: A longitudinal section through a spinning device from the patent application CH 2000/1845/00 of 22 September 2000 from the same applicant as a basis for the presentation of the following Figures 6 to 6c and 7 to 7c representing the invention.

Fig. 5a: A cross-section through Fig. 5, corresponding to the section lines II-II.

Fig. 5b: A section through Fig. 5, corresponding to the section lines I-I.

Fig. 5c: A part of the section of Fig. 5b, to represent special features.

Figs. 6 to 6c and 7 to 7c: In each case a longitudinal section, corresponding to Fig. 5b, in each case through a spinning device according to the invention.

Fig. 6.1, 6c.1, 7b.1, and 7c.1: In each case, a selected figure from the foregoing figures in order to emphasize certain features.

Fig. 8: Variants of the drafting device from Fig. 4.

Fig. 8a: Detail from Fig. 8.

Fig. 9: A variant of the device from Fig. 4a.

Fig. 10: A longitudinal section from a yarn according to the invention.

### DETAILED DESCRIPTION

~~The purpose of the description hitherto and the following supplementary description of the prior art is to show that an attempt has been made, in different manners, to obtain satisfactory circumstances for the product of the yarns referred to. Despite this, no reference can be drawn for the object of the present invention.~~

~~Fig. 1 to 1c and 2 to 2c have already been discussed in the Background section.~~

~~In principle, the identification references not mentioned of all these and also of the following figures of the prior art have no explanation in this application; i.e. only the identification references necessary for the understanding of the invention are used, and accordingly the other identification references could be disregarded; for the sake of simplicity, however, they have been left in the Figures.~~

Fig. 3 further shows a longitudinal section through a spinning device with a thread guide channel <sup>405a</sup> and a second thread guide channel <sup>405b</sup>. <sup>Parallel</sup>

In the fibre guide channel <sup>405a</sup>, on the one hand, a false twist is incurred by the rotating air flow N1' and, on the other, a false twist into a core fibre strand supported by

\* Reference will now be made in detail to the presently preferred embodiments of the invention, one or more examples of which are shown in the figures. Each example is provided to explain the invention, and not as a limitation of the invention. In fact, features illustrated or described in one embodiment can be used with another embodiment to yield still a further embodiment. It is intended that the present invention cover such modifications and variations.

the twist nozzle Na', which extends from the intake of the spindle <sup>464</sup> as far as the clamping gap <sup>x'</sup> of the two clamping rollers <sup>402</sup>.

Delivered around this extended core fibre strand fa' are fibres fb' raised from this, in the separate, i.e., parallel channel <sup>405b</sup>, against the intake aperture of the spindle <sup>404</sup>, which are taken up at that point by the circulating air flow N1', and turned about the falsely-rotated yarn core, and in this way producing the yarn characterized as Y'.

### DESCRIPTION OF THE INVENTION

① continued

The invention is described hereinafter. It is therefore noted ~~once again~~ that the identification references for the following figures have no relationship to the features of the prior art, and vice-versa.

Fig. 4 shows a drafting device 1 with four drafting rollers (two partially shown) and a pair of small drafting device belts, which convey the fibres between an upper clamping roller 2 and a lower clamping roller 3. Clamping rollers 2 and 3 in their turn convey a fibre strip 7 against a fibre conveying channel 8, through which <sup>7</sup> by means of an injector effect provided by blow-in nozzles 9, air is sucked in and the fibre strip 7 is brought into the fibre conveying channel 8.

At the outlet of the fibre conveying channel 8, the front ends of the fibres of the fibre strip are taken up and wound around the rear free ends in an inherently known manner, which are rotated by means of the air vortex referred to, as a result of which a yarn is provided and unwound at a specified unwinding speed. It should be noted in this context that throughout the term "front" and "rear" ends of the fibres relate to the direction of run of the fibres.

The fibre conveying channel is part of the fibre conveying element 10, which as shown, is located in carrier element 37 and is capable of replacement.

Fig. 4a shows, as a variant, instead of the lower clamping roller 3, a suction roller 4, by means of which the fibres are conveyed from the clamping gap between the upper clamping roller 2 and the suction roller 4 as a fibre strip 7 against the fibre conveying channel 8, and at that point, as described heretofore, are taken up by the air flow. The further procedure for the formation of the yarn corresponds to the procedure in Figure 4.

A suction area 5 is provided in the suction roller 4, by means of which air is sucked in from outside the suction roller 4, and in this situation the fibres are held on the surface and conveyed by the rotation of the suction roller 4 against the fibre conveying channel and then released again at the end of the suction area at a fibre discharge point P. The air of the suction area 5 is drawn in through a suction aperture 6.

Fig. 5 to 5c correspond essentially to Figs. 2 to 2b and 2.1 to 2b.1 of the application mentioned earlier (CH 2000/1845/00), which are integrated constituent parts of this application or are at least referred to therein.

Fig. 5 represents in diagrammatical form, by means of a line, a suction roller <sup>539</sup> 39, analogous to the suction roller 4 of Fig. 4a, which, however, in contrast to Fig. 4a, delivers the fibres <sup>F'</sup> into the fibre conveying channel <sup>526</sup> 26 not from top to bottom but from bottom to top. In this channel, the fibres are conveyed in the conveying direction <sup>525</sup> 25 on the fibre guide surface <sup>520</sup> 20 as far as the fibre delivery edge <sup>529</sup> 29, shown in Fig. 5c. After this fibre delivery edge <sup>529</sup> 29, the front ends of the fibres <sup>F'</sup> are bundled in the spindle intake aperture <sup>535</sup> 35 in an area designated at N'' and are conducted into the yarn guidance channel <sup>545</sup> 45, while the rear ends <sup>549</sup> 49 of the fibres <sup>F'</sup> are laid around the spindle <sup>532</sup> 32 and



rotated by the rotating air flow created by the nozzles <sup>521</sup>21, as shown in Fig. 5 and 5b, as a rule around the mouth section of the spindle <sup>532</sup>32, with the result that the rotation of these free ends results in a yarn <sup>541</sup>41 with real twist.

The fibre conveying channel <sup>526</sup>26 is part of a fibre conveying element <sup>527</sup>27, which is incorporated in a replaceable manner in a carrier element <sup>537</sup>37. The carrier element <sup>537</sup>37 is permanently integrated on the other side into a nozzle block <sup>520</sup>20.

The cross-section of Fig. 5 in Fig. 5a shows the same elements. It can also be seen that there are four nozzles <sup>521</sup>21 involved, which create the rotating air flow for the free fibre ends.

It can be seen from Fig. 5b that the fibres <sup>F'</sup> gradually bind together from one fibre take-up edge <sup>531</sup>31 to another take-up edge <sup>529</sup>29 (Fig. 5c), and, specifically because of the movement of the fibres and the bundling effect of the fibres located in the yarn guide channel <sup>545</sup>45, they bind together into a fibre binding and winding area designated as the bundle point N."

As mentioned in CH 2000/1845/00 referred to heretofore, the spinning process must commence with a spinning start process, in order for the front ends of the fibres to be actually taken up into the spindle intake mouth <sup>535</sup>35. On the other hand, it is also essential that sufficient free rear ends of the fibers are obtained in order for these ends, as designated with the identification reference <sup>549</sup>49, to be able to lie about the spindle front surface <sup>534</sup>34 (Fig. 5c) and to rotate thereon, in order for the binding-in process to take place.

Figure 10 shows in diagrammatic form a section from a yarn <sup>46</sup>~~45~~ with a front fibre end 52 bound in and a rear fibre end 51 wound around, which surrounds the yarn body 55 by a winding length 54. The direction of run of the yarn is designated by <sup>53</sup>~~46~~.

This process is essentially already described in the patent application referred to heretofore, and further comment at this point is therefore refrained from.

The obtaining of sufficiently long free ends depends on the one hand on the length of the individual fibres, which is determined under laboratory conditions in what is referred to as a staple diagram, and, on the other, from the distance between the clamping line K of two <sup>clamping 2:3</sup> output rollers, as shown in Fig. 4, or the fibre discharge point P at a suction roller <sup>4</sup> as shown in Fig. 4a and the spindle intake mouth <sup>of the spindle 32</sup> 35. These two intervals are also designated here as the "clamping length".

In order on the one hand to improve the obtaining of sufficiently long free ends, and, on the other, to reduce the dependence on the clamping length referred to, according to the invention, as shown in Figures 6 to 7c, the fibre flow is divided into at least two parts, whereby the one part is considered primarily as what is referred to as the short or core yarn fibres part, and the other part primarily as what is referred to as the long or cover yarn part, in order, by means of better adaptation to the clamping length and the winding length 54, to improve the uniformity and strength of the yarn. The two terms referred to, "short or core yarn fibres part" and "cover yarn part" were created for this description and are not to be regarded as general technical terms.

In this situation, in the spinning start process referred to, the yarn end guided by the spindle backwards against the output rollers of the drafting device or against the suction roller is conducted into the core yarn fibres part.

As a rule, the core yarn fibres part involves an essentially extended channel, i.e. ~~through which core yarn fibres  $F_1$  are conducted~~ <sup>fibers  $F_2$</sup>  a channel without bends ~~while the cover yarn threads~~ are more usually conducted in the channel with bends, i.e., is conducted in the cover yarn part. If three channels are used, as a rule the middle channel is the core yarn fibres part. The two outer channels, provided with a bend, may feature the same or different bending, in order to achieve a different mean conveying length (24 to 24.11) and a different impact angle  $\alpha$  or  $\beta$  respectively. In this situation, as shown by Fig. 6.1, 6c.1, 7b.1 and 7c.1, the angle  $\alpha$  ~~is~~ <sup>converges on</sup> enclosed by the bundle point ~~N~~ <sup>(N.3, N.6, N.7)</sup> in which the middle conveying lengths cross at a tangent T imposed at a bent middle conveying length 24, and by the mid-line 47 of the spindle. The angle  $\beta$  is enclosed on the one side by the mid-line 47 and either by a middle conveying length 24 or by a tangent T.1 in the bundle package ~~N~~ <sup>(N.3, N.6, N.7)</sup> at a middle conveying length.

In this situation the different middle conveying lengths in the four figures referred to are designated in brief only as 24.

In addition to this, the bent movement results in a greater conveying length in relation to an extended middle conveying length, with the result that the front ends of fibres of equal length, which enter the corresponding channel at the same time, while moving at the same speed do not reach the bundling point N referred to at the same time, due to the differing conveying length. That is to say, the front end of the fibre on the shorter path is bundled earlier than the other fibres on the longer path. If the possibility is also taken into account of being able to obtain different speeds because of different channel cross-sections, then the possibility also pertains of achieving a temporal difference for the attaining of the binding area of the two fibres. Expressed

another way, there is the possibility of several adjacent distances being obtained  
 (as seen in Figures 4, 6, & 6B) (as seen in Figure 4a) between the clamping line K or a fibre discharge point P at the suction roller and the bundling point N. That is to say, there is a greater range of the said distances, in order better to adapt the length mixture of the fibres in the fibre bundle.

In addition, there are fewer "floating" fibres, i.e., fewer fibres which are no longer held back and are not bound in at the front, which reduced fibre loss due to outgoings.

Moreover, the impact angle  $\alpha$  (designated as such for this application) or  $\beta$  respectively has a certain tendency to release the rear ends, since to a certain extent a preliminary effect in geometric terms has already been carried out for these ends to be kept free.

A further possibility pertains in designing the cross-section of the channels in such a way that the channel is widened in cross-section towards the end, i.e., in the direction of the bundle point N, in such a way that a delay occurs in the air flow, the consequence of which is that the fibres have a tendency to be positioned transverse to the direction of conveyance, as a result of which the rear ends have a tendency to reach the bundle point or the binding-in area referred to, at a greater angle than the angle  $\alpha$  or  $\beta$  respectively.

In Figs. 6 to 7c, different variants are therefore shown in order to take appropriate account of the aspects referred to heretofore.

Fig. 6 shows the suction roller 4, in which an intermediate element 16 subdivides the suction roller into a left-hand suction part 12, seen in the direction of conveying 11, and a right-hand suction part 13, so that a fibre strip from the clamping line K in the

conveying direction 11 is divided into two parts, and specifically in a width which accords with the corresponding intake widths of the following fibre channels 14 and 15.

Shown in the channel 14 is a middle conveying length 24.12 and in the conveying channel 15 a middle conveying length 24.13, whereby, as can be seen, the length 24.12 is greater than the length 24.13. Both lengths meet at the bundling point N, which is always located inside the spindle intake mouth <sup>of the spindle 32</sup> 35, essentially in the same area. Despite this, the individual bundle points N are individually numbered with an index number.

For the start of spinning, the yarn end referred to earlier is guided back through the channel 15 onto the suction roller 4. Accordingly, care must be taken to ensure that fibres in the channel 14 reach their destination location as far as possible without loss, as a result of which a guide wall 33 is provided for as far as the fibre discharge edge 29.

The same applies to Fig. 6a with the guide wall 33.1. In this variant, the angle  $\alpha$  shown in Fig. 6b is greater than that in Fig. 6; i.e. in this case, what is referred to as the angle effect is required to be somewhat stronger than in Fig. 6.

In principle it should be repeated that the fibre conveying elements <sup>27.1, 27.2, 27.3, 27.4</sup> 27, in which these channels are inserted, are capable of being exchanged; that is to say, the channels can be adapted to the corresponding fibre material.

In principle, the optimum width ratio of one channel to the other, the optimum ratio of the middle conveying lengths, and possibly the optimum location of the bundle point N and the optimum angle  $\alpha$  and  $\beta$  must be determined empirically, depending on the fibre mixture, for all variants of the figures shown.

The channels of Fig. 6, Fig. 6a and Fig. 6c are all formed in such a way that the air, and the fibres respectively, undergo a predetermined acceleration from start to finish, while in the channel 14.2 of Fig. 6b, it is primarily an acceleration of the air which takes place as far as the culmination point of an intermediate wall 38.2, while thereafter, as far as the end of the channel, due to the widening of the channel itself, the air flow is slowed down in a predetermined manner, in order to obtain the effect referred to earlier; namely, that the fibres tends to move in the transverse direction to the channel. On the other hand, the acceleration of the fibres has the advantage that the fibres reach the node point stretched and essentially in this position.

In principle, in the figures elements with the same functions are provided with the same basic identification references, and an additional index number corresponding to the figure; for example, the conducting wall 33 from Fig. 6 in Fig. 6a is a "conducting wall 33.1".

In Figs. 6 and 6b and 7 and 7b, a suction roller 4 is shown in each case. There is also the possibility, however, of the fibre bundle being delivered from a drafting device, whereby in such a case the fibre bundle must already be divided into the two parts desired in the drafting device. The same applies to Figs. 6a and 6c and 7a and 7c, in which no suction roller is shown, but which could likewise be used.

Figs. 7 to 7c feature as variants three channels instead of two, whereby the angles of incidence  $\alpha$  and  $\beta$  may optionally be the same or different for the channels <sup>(14.4, 14.5, 14.6 and 14.7)</sup> and <sup>(15.4, 15.5, 15.6 and 15.7)</sup> depending on the fibre material, while the middle channel <sup>(23, 23.1, 23.2 and 23.3)</sup> as a rule features a middle conveying length <sup>(24.1, 24.4, 24.7, 24.10)</sup> which is located as a rule in the same plane as the middle line

47 of the spindle 32. In this situation, this plane is located perpendicular when looking at the figures.

Corresponding to the three channels, the suction roller 4 in Figs. 7 and 7b is additionally provided with a middle suction part 19. The suction parts <sup>12.1, 13.1</sup> 12, ~~13~~ and 19 are subdivided by the intermediate elements 17 and 18.

The guide walls 33.4, 33.5, 33.6, and 33.7 are conducted as far as the fibre discharge edge 29, in order to guide the fibres in such a way that, as mentioned earlier, they can be taken up in the binding-in area practically without loss.

In Figs. 7 and 7a, the fibre conveying channels are designed in such a way that the air, and therefore also the fibres, undergo acceleration from the beginning to the end, while the conveying channels of Fig. 7b are of such a nature that the air in the middle channel accelerates while the air in the outer channels is slowed down in the end area.

In Fig. 7c, the air in the channel 14.7 and 23.3 features an acceleration, while that in the channel 15.7 undergoes slowing in the end area.

All variants of Figs. 6 to 7c are only examples for realizing the aspects of the invention mentioned in the preamble, as a result of which the invention is not restricted to this, other variants also being conceivable within the scope of the concept of the invention.

With the Figures 6.1 to 7c.1, the angles  $\alpha$  and  $\beta$  and the channel cross-sections A, B, and C are shown. This is intended to show that in Fig. 6.1 the channel 14 <sup>see also F</sup> (Fig. 6) undergoes widening to C after the cross-section B being narrower than A. The same <sup>in Fig. 7b.1 see also</sup> applies to the channels 14.6 and 15.6 <sup>in Fig. 7c.1 see also</sup> (Fig. 7b) and to the channel 15.7 <sup>see also</sup> (Fig. 7c).

The difference between the angles  $\alpha$  and  $\beta$  is clearly shown in Figures 6.1 and 6c.1, while in Fig. 7b.1  $\alpha$  and  $\beta$  are about the same size, and in Fig. 7c.1  $\alpha$  is a little greater than  $\beta$ .

The figures show variation possibilities; the effective values must be determined from case to case.

It may further be mentioned that more than one fibre bundle  <sup>$F_2$  and  $F_3$</sup>  can be delivered from the drafting device or from the suction roller <sup>as seen in Figures 6b & 6c</sup> in order to obtain differences in the middle fibre lengths in the corresponding fibre bundles.

If more than one fibre bundle is delivered from the drafting device or the suction roller, the possibility likewise pertains of delivering not only different fibre lengths but also different fibre types per fibre bundle; i.e. the synthetic fibres, which are longer, for example, can be delivered in that channel which features the longest conveying length, while the staple fibres are delivered to the channel(s) which feature(s) shorter conveying lengths.

The possibility also <sup>exists</sup> ~~pertains~~ of delivering the synthetic fibres in that channel which features the shortest conveying path, and thereby tends to deliver core fibres rather than the channel with the longer conveying path <sup>delivering</sup> ~~and with the~~ staple fibres, which then take over the function of the sheath fibres, with the result that a yarn features essentially synthetic fibres in the core and staple fibres in the sheath.

It is possible, in particular, if three channels are used, for the synthetic fibres to be conducted in the middle channel and the staple fibres to be conducted in the outer channels. In this situation, however, it must be borne in mind that the conveying lengths of the outer channels feature a size adapted to the staple fibres. It does not matter in



this context that the inherently longer synthetic fibres in the center feature a shorter conveying path than the staple fibers.

Figs. 8 and 8<sup>a</sup> show a variant of Fig. 4, in that, in addition, a tension roller 43<sup>f</sup> is provided for, which is provided with a roller part 43.1 and a roller part 43.2, whereby the roller part 43.1 features a smaller diameter than the roller part 43.2. In this situation, the roller part 43.2 is located with the circumference on the fibre guide bottom of the fibre conveying channel 8.1, while the roller part 43.1 with the smaller diameter results in a gap, corresponding to the diameter different, between the circumference of the roller 43.1 and the bottom of the fibre conveying channel 8.1, so that the fibres in this area have a free passage from the clamping line K to the intake mouth of the spindle 32, which is characterized by the distance interval M.

On the other hand, the roller part 43.2 forms a clamping line K.1 with the bottom of the fibre conveying channel 8.1, with the result that an interval M.1 pertains between this clamping line and the intake mouth of the spindle 32.

With this variant, the possibility pertains of relatively short fibres being delivered and spun in, the rear end of which is still clamped in the clamping line K.1, while the front end is already bound into the mouth of the spindle 32.

This variant accordingly shows a further possibility of varying middle conveying lengths in addition to the variants shown in Figs. 6 to 7c.

In this situation, elements are provided with the same identification references as in Fig. 4.

The tension roller 43 is driven by means of a overhead drive 44 from the shaft of the clamping roller 2 in such a way that the circumferential speed of the tension roller 43.2 corresponds to the circumferential speed of the roller 2.

The difference between the diameter roller parts 43.1 and 43.2 is of such a nature that the fibre flow between the clamping line K and the mouth of the spindle 32 on the bottom of the fibre conveying channel 8.1 is not disturbed.

Fig. 9 shows a variant of Fig. 4a, in which the same elements feature the same identification references and accordingly are not described again.

The variant to this figure consists of the fact that a tension roller 43.<sup>3</sup> is provided for, which presses against the circumference of the suction roller 4, in order to form a clamping line between the circumference of this roller and the circumference of the suction roller 4, in order for the release of the fibres from the suction roller 4 into the fibre conveying channel 8.1 to take place in a predetermined and not variable manner.

The roller 43.<sup>3</sup> is spring-supported, which is represented by the symbolic spring 50.1. The same applies to the tension roller 43 in Fig. 8, whereby in this case the spring is designed by 50.

The variant of Fig. 9 is combined with the channels shown in Figs. 6 to 7c.

The drive for the roller 43.<sup>3</sup> is provided by the suction roller by means of the friction between the surface of the tension roller 43.<sup>3</sup> and the fibre bundle 7, which features a friction relationship with the surface of the suction roller 4.

The tension roller 43 in Fig. 8 may in addition be provided with longitudinal grooves, in order for the suction air caused by the nozzles 9 to pass through the fibre conveying channel 8.1.

The possibility likewise pertains of designing the tension roller 43 as a perforated hollow roller, so that the air can pass through the perforation from the space between the rollers 2 and 3 into the fibre conveying channel 8.1.

The advantage of such a roller further pertains in that, due to air passing from the inside of the roller through the perforation into the fibre conveying channel 8.1, the fibres are actively released from the surface.

A further variant consists of provided the surface of the roller part 43.2 with fine circumferential grooves, which likewise allow for air permeation.

As far as the terms "core yarn fibres" and "cover yarn" are concerned, it may further be mentioned that there is no precise delimitation between "core yarn fibres" and "cover yarn", since the rotation of the fibres in the yarn of "non-rotated" or "scarcely-rotated" fibre parts in the interior of the yarn gradually grows to the "most thickly rotated" fibres or fibre parts at the circumference of the yarn. Instead of "core yarn fibers" and "cover yarn", it is also possible to speak of fibres or fibre areas which tend to be located in the interior, and of fibres or fibre areas which, by contrast, tend to be located against or at the circumference of the yarn.

There is likewise no restriction with regard to the length of the fibres or fibre areas which tend to be located in the interior or at the circumference of the yarn.

Within the scope of this spinning process, incidentally, the term "migration" of the fibres or of the fibre areas is also used in the context of the build-up of the yarn, in which, seen in the direction of run, front areas of the fibres tend to be located in the interior area of the yarn and the rear part of the fibre tends to be located in the outer

area of the yarn. This so-called "migration" or "build-up" of the yarn provides the advantageous nature and quality of these yarns.

Lastly, reference may be made to the fact that a strip division, as shown in Figures 6, 6b, 7 and 7b, can be obtained by the use of a suction roller 4, because in the areas 16 (Figure 6, 6b) and 18 (Figure 7, 7b) no air is sucked in, with the result that the fibre strip is divided into the areas 12 and 13 (Figure 6, 6b) or into the areas 12.1, 13.1, and 19 (Figure 7, 7b). The same applies to the arrangement of Figure 9 and Figure 8, if a suction roller 4 is used in the arrangement of Figure 8 instead of the roller 3, which is hereby proposed as a variant for this Figure 8.

In the arrangement of Figure 8 shown, two small parallel strips with different middle fibre lengths are guided through the same drafting device, whereby the small fibre strip with the shorter fibres is clamped by the roller 43.2 in the clamping line K.1, while the small fibre strip with the longer fibres is guided in the gap between the roller 43.1 and the fibre guide surface (no identification reference) of the fibre conveying element 10.1.

It should be appreciated by those skilled in the art that modifications and variations can be made to the embodiments of the invention described herein without departing from the scope and spirit of the invention as set forth in the appended claims and their equivalents.

## **ABSTRACT**

The invention relates to a spinning device for the manufacture of a spun thread from a fibre bundle, surrounding a nozzle block with one or more nozzles, which take effect on a fibre bundle which is conveyed against a spindle. The rear fibre ends are taken up and rotated in the direction of rotation of the air flow in such a way that they rotate the front ends of the fibres which are already located in the yarn guide channel to form a yarn. Channels having different conveying lengths conduct the fibers to the spindle.